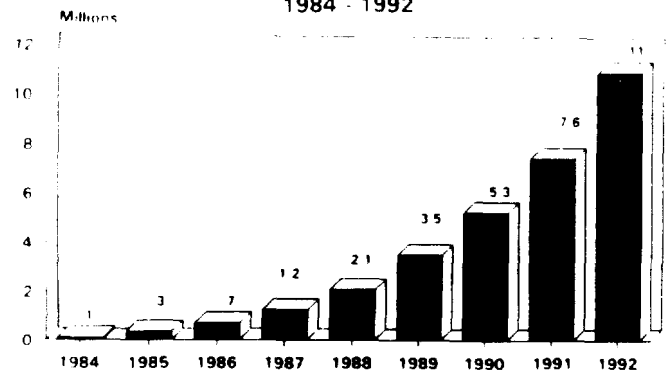


Cellular also enhances the productivity of the rest of the workforce, bolstering sales in a whole range of businesses, and providing for increased efficiency in the management of time and assets.

Subscribers: The cellular industry has surged to new heights, adding nearly 3.5 million new users in the past year, to serve over 11 million subscribers. Another 9,500 new subscribers sign up every day.

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Cellular Serves Many American Needs

Who uses cellular service? Real people, with real needs. Men and women who are concerned with business, with home, and with safety.

Cellular can provide benefits at reasonable prices, to an increasingly mobile and dispersed population. Over 112 million people commute to work, roughly 20 million take work home, 10.3 million are self-employed, and 1.9 million work exclusively at home. And millions more travel in connection with business.

What cellular service offers people is freedom: freedom from a specific location. Cellular allows people to call and be called, wherever and whenever they choose. Cellular provides the means for people to feel safe, to keep in touch, to be on the move. Over 11 million are already using it to for these purposes.

In fact, the personal use of cellular service grew to equal business use by the end of 1992 according to Economic and Management Consultants International's (EMCI) CellTrac Survey. EMCI has also found that the fastest growing categories of users are those interested in personal applications.

The powerful reality and potential of the cellular industry attracted 7,000 attendees -- from 47 countries -- to the WIRELESS '93 CTIA Conference and Exposition held in Dallas in March. And 282 companies displayed a wide and exciting array of products and services in 785 booths.

The Wireless World -- More Than Just Cellular

The wireless world is, and will be, made up of more than cellular services. Millions of Americans, and thousands of companies, use a wide range of wireless services. Over 25 million people already use cellular, paging and Specialized Mobile Radio (SMR) services, and the current mobile data market alone has been estimated at 15 million potential users. EMCI recently estimated that the larger market for wireless services will grow to 60 million by 2000.

The wireless service world is composed of:

- ◆ **Basic Exchange Telecommunications Radio Service (BETRs)** - radio-based local exchange services provided by common carriers in rural areas where the costs of traditional wired services are very high.
- ◆ **Broadband Video** - examples include the recently approved Suite 12 "CellularVision" (28 GHz Local Multipoint Distribution Service) proposal, which would include multipoint video program distribution, videoconferencing, telecommuting, telemedicine and educational telecommunications services.
- ◆ **Cellular** - a radio-based service, in which geographic service areas are divided into "cells," permitting frequency reuse to maximize spectrum utilization in providing service to vehicular, transportable and portable units. Over 11 million people already use cellular service.
- ◆ **Cordless adjuncts** to local exchange networks -- one example is Ericsson's Freeset, which is capable of voice and data transmission with wireless PBXs.
- ◆ **Mobile Satellite Services** based on Low Earth Orbit satellites (LEOs), including Motorola's Iridium project, Orbital Sciences Corp.'s Orbcomm, Inmarsat's Project 21, Loral-Qualcomm's Globalstar, Ellipsat, and Leo One Panamericana of Mexico City.
- ◆ **Paging** - traditionally paging has been a one-way, low cost, message service. Beyond traditional paging services, advanced paging services involving two-way messaging, acknowledgement features, and message storage capabilities. Advanced paging services have been proposed by Mtel, PageNet, Dial Page, Page America, Arch Communications, and ProNet, and include Motorola's Electronic Mail Broadcast to a Roaming Computer (EMBARC). Over 10 million people already use traditional paging services.
- ◆ **Personal Communications Services (PCS)** - examples of prospective services include Data-PCS proposed by Apple Computer. CableVision Systems Corp. of Woodbury, NY, has also announced the demonstration of mobile cable-based PCN using Motorola's Silverlink handsets and Neighborhood Hardware Corridors (in which coaxial cables are strung with remote antenna drivers and microcell extenders in order to provide a seamless coverage area).
- ◆ **Specialized Mobile Radio (SMR)** - this two-way non-interconnected service is projected to expand to encompass interconnected voice service, and to compete directly with cellular in light of end-user delicensing, and technical and financial developments. Providers include American Mobile Systems, JCC Holdings, and Transit Communications; NEXTEL Communications (the Fleet Call/DisCom combination); and Motorola's Integrated Radio Service (MIRS).

- ◆ **Traditional Radio Services** - traditional radio services encompass radio-based services serving specific niche markets, such as the Local Government Radio Services, Special Emergency Radio Services, the Industrial Radio Services, and Land Transportation Radio Services. Users of these services have traditionally been entities engaging in communications essential to the internal or official activities of the licensees. Some classes of licensees are permitted to provide service to other entities or individuals who are themselves eligible for licensing.
- ◆ **Wide Area Paging** - wide area paging provides regional or national paging capability. One such provider is SkyTel Corp., which offers a national SkyPager service. Over 2.6 million people already use wide area paging services.
- ◆ **Wireless Cable** - involves the distribution of video entertainment programming by alternative multichannel video providers using frequencies in the 2, 6, 18 and above 21.2 GHz bands (in the Multipoint Distribution Service, Multichannel Multipoint Distribution Service, Instructional Television Fixed Service, Cable Television Relay Service, and Private Operational-Fixed Microwave Service). Companies providing wireless cable include ACS, Cable Technology, and Peoples Choice TV Partners.
- ◆ **Wireless Cities** - the long-predicted wireless city is now a reality, with GTE migrating the city of Quitaque, Texas, to a new Ultraphone digital wireless telephone system supplied by InterDigital Communications Corporation. This entirely wireless system is capable of providing voice, fax and data transmission. Similar wireless city systems are planned for deployment in early 1993 by companies such as the Haviland Telephone Company of Kansas.
- ◆ **Wireless/Mobile Data/Wireless Computing** - mobile data systems and networks have been proposed or developed by Motorola, AT&T, General Magic, Sony, Apple, News Electronic Data, Ericsson. Currently operating digital packet offerings include the IBM/Motorola Advanced Radio Data Information Service (ARDIS) and RAM Mobile Data's two-way digital networks. Such networks have also been proposed or established by Cellular Data Inc. and Westinghouse Electric Systems and Bell Atlantic Mobile (jointly), Mtel's Nationwide Wireless Network (NWN), and QUALCOMM. EO Inc. (in partnership with AT&T, Matsushita, and Marubeni) is also offering a Personal Communicator combining wireless telephone, fax and computing, using stylus input for entry. The data can be stored for future reference, transferred to desktop machine or faxed.
- ◆ **Wireless Electronic Mail** - examples include Motorola's EMBARC, and Ericsson's Viking Express.
- ◆ **Wireless Facsimile** - examples include Vanguard's cellular fax offering, and RadioMail Corporation's proposed wireless fax adjunct to its E-mail offering.

- ◆ **Wireless PBX/Centrex** - examples include Motorola's Silverlink and Northern Telecom's Companion. Ameritech is currently conducting trials of wireless centrex systems. Qualcomm equipment is also being deployed by Local Area Telecommunications, Inc., in the New York and New Jersey offices of Bear Stearns & Co.
- ◆ **Wireless Tracking/Direction Finding** - Automatic Vehicle Monitoring systems are used to locate and track vehicles using non-voice methods, relaying information to and from vehicles. The FCC has proposed expanding the service to encompass location of all objects, and transmitting and receiving status and instructional messages, under the name of the Location and Monitoring Service.

This is only an illustrative list of the upcoming wireless marketplace -- many more services and uses are likely to be unveiled in the future. Future wireless applications have unlimited potential, and will include service offerings not yet imagined.

Government Policies Can Help Wireless Technologies Grow

The reality and potential of the world of wireless technologies and services has been recognized by government policymakers. Vice President Al Gore has stated that government policy should encourage "more-rapid development of fiber-optic and wireless networks capable of carrying full un-compressed video and other applications." Commissioner Ervin S. Duggan of the FCC has said that "wireless is where the excitement is today: wireless fax, wireless data transmission, personal communications services, wireless tracking and direction-finding, wireless video, wireless everything." Robert Pepper, Chief of the FCC's Office of Plans and Policy, has also observed that "many of the newest and most exciting communications technologies allow people to communicate from different places and while on the move."

In pressing forward with new technology initiatives, policymakers should be careful not to injure the real and growing information marketplace. In trying to encourage companies to develop and deploy new technologies, policymakers should recognize how broad and richly innovative the infrastructure already is.

Government policymakers should adopt a uniform, pro-competitive national policy encouraging the growth of an information age infrastructure which encompasses the full range of wired -- and wireless -- technologies in order to ensure the rapid deployment of services and equipment to meet the needs of all Americans. In particular, no parties should be excluded or preferred in allocating or auctioning new spectrum for wireless technologies. Disparate, asymmetric regulatory treatment of similar wireless services should also be avoided so that future wireless investment is not constrained in any area.

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1133 21st Street, N.W. Suite 300, Washington, D.C. 20036 FAX 202-785-0721
Michele Farquhar, V.P. for Law & Regulatory Policy, 202-785-0081
Robert F. Roche, Director of Research, 202-785-0081

CELLULAR *Brief*

CTIA[®]

DEC. 17, 1992

CTIA's UPDATE ON KEY WIRELESS POLICY ISSUES

The Changing Wireless Marketplace

Presented to CTIA by EMCI, Inc. December 1992

Technology, economics, and regulation are converging to push wireless forward into the next century. Advances in digital technology, economies of scale, increased awareness of wireless, and regulatory flexibility are the main forces behind the future growth of wireless. Over the next decade, wireless devices and wireless networks will be the dominant mode of communication in the U.S.

The Changing Face of Communications: Emerging Wireless Technology and Services

The mobile communications industry is the fastest growing segment of the telecommunications industry. The rise in prominence of wireless technology, products, and services, has impacted the way in which business and personal lives are conducted. Changes are taking place within existing wireless services, as well as through the introduction of new services. Currently, the major mobile communications technologies are:

- **Cellular.** With over 10 million subscribers in the U.S., the cellular industry has grown rapidly since its inception in 1983. Cellular is available to approximately 85% of the U.S. population in both metropolitan and rural areas.
- **Paging.** Paging is currently the technology of choice for those who need mobile communications, but do not require voice communications. Much of paging's growth in the past few years has been driven by low prices and entry into the consumer market. There are some 14 million paging subscribers in the U.S.
- **Specialized Mobile Radio (SMR).** Although little known outside of the mobile communications industry, SMR provides businesses with mobile radio services to meet internal communications needs. Currently, there are approximately 1.4 million users of SMR. In the future, digital technology is going to allow SMR to provide services which will compete directly with cellular.

EMCI, Inc.
1130 Connecticut Avenue, NW, Suite 325
Washington, DC 20036 202-835-7800



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In the future, there will be other services which will play a prominent role in the wireless market:

- **Mobile satellite.** There are several proposed mobile satellite services, many of which aim to provide wireless portable phone coverage in areas not reached by cellular. Additionally, mobile satellite services are expected to bridge the gap among incompatible international cellular systems.
- **Mobile data.** The convergence of communications and computing has been recognized by a variety of mobile data service providers. These services include remote database access by a laptop, facsimile transmission, inventory tracking, and numerous other applications.
- **Personal Communications Service (PCS).** Although not yet fully defined, PCS is expected to facilitate a variety of new services which are expected to be priced below existing mobile communications services. PCS will therefore appeal to a wider cross-section of the population, offering lower airtime prices and lightweight, inexpensive handsets. It is expected that the FCC will grant 3-5 PCS licenses per area by 1996.

Rapid Mobile Communications Subscriber Growth Reflects Changing Markets and Services

Combined, paging, cellular, and SMR reached 20.5 million subscribers by the end of 1991, or 8% of the population. This growth has been fueled by a combination of changing market demand and new services. Historically, all three technologies catered primarily to the business market, and were distinguished by their functional capabilities. Paging was primarily a one-way, low cost, message service while SMR was primarily a two-way, non-interconnected voice, medium cost service. Cellular offered two-way, interconnected voice capabilities, but at a relatively higher price.

Mobile communications subscriber growth in recent years has been driven by entry into the consumer market. Both paging and cellular have penetrated the consumer segment through new distribution strategies and tailored price plans. While SMR has not yet reached the consumer market, it is poised to do so in the near future. Changes in regulation, technology, industry structure, and market demand will allow SMR to cost-effectively provide services identical to cellular and serve the consumer segment. The forces behind this change are discussed below.

There are other new technologies, such as mobile satellite and mobile data, that will also compete for wireless subscribers. Mobile satellite will provide services to high end business users, as well as those who require mobile communications services, but cannot be reached by terrestrial systems. Mobile data services will compete both in the business and consumer segments, providing a non-voice alternative for mobile communications.

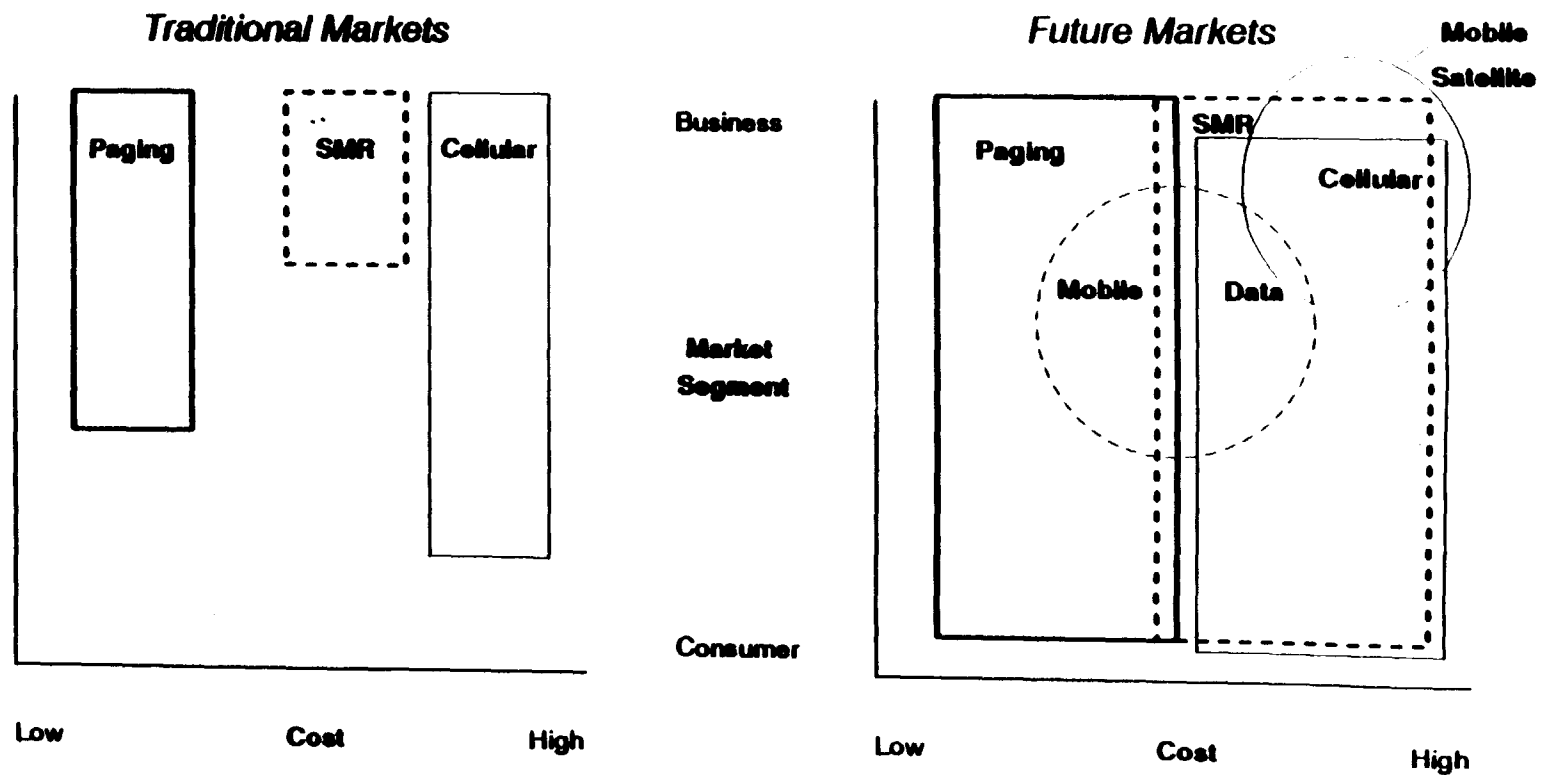
Technological and Market Forces Result in Increased Competition Among Mobile Communications Services

As technology, regulation, and market structure change, paging, SMR, cellular, mobile data, and mobile satellite services will compete more heavily against one another. Figure 1 illustrates the shift in market segments and resulting overlap as SMR and paging are able to cost effectively provide services which may be substituted for cellular. The wide scale introduction of mobile data and mobile satellite will also expand the basket of services that are available, as well as introduce more competition to the marketplace. These changes have begun already on a limited scale and will accelerate rapidly in the mid 1990s as the new technologies are widely adopted within industries.

The changes in technology enhance both the functionality and capacity of paging and SMR relative to cellular. SMR will grow from a primarily two-way dispatch service to encompass interconnected voice service, thus serving the consumer segment. Paging will grow from a primarily one-way, non-voice service to encompass two-way messaging and voice service, therefore increasing its reach into new demand segments. High capacity digital SMR and paging systems that implement frequency reuse will provide the means for increased services and competition. Specifically, the factors influencing increased competition include:

- **The shift in industry growth from business to consumer segments.** In the U.S., the profile of the mobile user has been shifting away from higher income professionals, who use their phones mainly for business purposes, to more personal use oriented consumers. This can be demonstrated, for example, by the lower average monthly bills of cellular subscribers, dropping from \$95 to \$75 per month in a period of three years. In order to compete for the consumer market, operators will offer lower cost services and products, as well as new innovations, which will provide further impetus for growth. New PCS licenses, in large part, are being granted to facilitate wireless entry into the mass market.

Figure 1. Mobile Communication Target Markets, by Technology



Note: Excludes PCS.

Source: EMCI, Inc.

- **Regulatory flexibility leads the way toward service overlap.** Over the past few years, the regulatory environment facing all mobile communications service licensees has generally been designed to promote competition and the provision of new and improved services. In the process of encouraging innovation and competition, the functional distinctions among mobile communication services has become blurred. As discussed below, regulatory actions regarding SMR and paging have significantly changed its future role in the wireless marketplace.
- **Technical advances blur service capability distinctions.** Advances in mobile radio technology are reducing the differences among mobile communications services. The most significant developments, digital technology and frequency reuse, allow all mobile communications services to increase capacity and provide new and enhanced services. For SMR, digital will allow more interconnected use through the more efficient use of spectrum. For paging, digital will provide greater capabilities for voice and acknowledgement messaging.
- **Economies of scale reduce service and equipment costs.** Mobile equipment manufacturers have achieved significant economies of scale in producing mobile communications products. It is therefore now less expensive to produce equipment, resulting in lower consumer prices and more innovative products, such as small portable phones and pagers with message storage capabilities. Benefits of manufacturing economies of scale have also lowered infrastructure equipment costs, and thus decrease barriers to entry for establishing a mobile communications network.

SMR in the Digital Age

- Digital SMR, particularly in conjunction with frequency reuse schemes, will provide services similar to cellular.
- SMR operators, such as Fleet Call and Motorola, have considerable resources and expertise from which to draw. This will allow them to more effectively implement and finance new digital systems and reach new market segments. Fleet Call intends to implement digital SMR in six top metropolitan markets by 1994 while Motorola has agreed to implement digital in its top 50 SMR markets. Combined, Fleet Call and Motorola SMR subscribers represent approximately one-third of the current total SMR subscriber base.

- Over the past few years, there has been a trend toward deregulating the SMR industry. Recently, the FCC has dropped restrictions which preclude SMRs from employing frequency reuse (and thus implementing a cellular-like system) and removed end-user licensing requirements, which had restricted marketing to non-business users.
- In addition to digital technology, innovations in billing and roaming hardware and software are increasing the capability of SMR subscribers to use their terminals outside of their home market. SMR operators also offer value-added features, such as mobile data capabilities, which make the service more attractive.
- SMR operators and end-users are facing lower costs due to economies of scale. Even for newer digital SMR equipment, manufacturers, including Motorola and Matsushita, have recognized the potential for economies of scale and will offer equipment at costs comparable to that of digital cellular equipment.

Paging: New Competition for Mobile Messaging

- Advanced messaging technologies will enhance paging's functionality, and thus make it more competitive with other wireless services. These advanced messaging services, such as store-and-forward voice messaging, and message acknowledgement, will provide additional capabilities which will appeal to new users. Store-and-forward services allow the user to store a voice message for retrieval at a later date. Message acknowledgement allows a sender of a page to know if the message has been received by the intended party.
- Companies that have submitted proposals to the FCC for new paging services include: Mtel, Dial Page, and Pagenet.
- As the mobile communications market evolves toward price-sensitive consumers, traditional lower cost paging will become more attractive relative to other wireless services. Paging's presence in the consumer segment will grow with the introduction of pagers in retail stores, and innovative paging designs.

Mobile Satellite: The Ubiquitous Wireless Service

- Mobile satellite two-way voice service will target two primary demand segments: people who are not otherwise covered by cellular and high-end international business travelers who do not want to contend with multiple, incompatible cellular systems across countries.
- Mobile satellite will also offer non-voice services, such as telemetry and vehicle location, which will appeal to certain niche markets.
- There have been numerous proposals put forward on mobile satellite system configuration which will offer varying levels of service. This includes low-earth orbit and geostationary satellite systems.
- Some of the prominent companies involved in mobile satellite include Hughes, McCaw, and Mtel (through the American Mobile Satellite Corporation), Ford, and TRW.

Mobile Data Brings Together Computing and Communications

- Mobile data services may be offered over cellular, SMR, satellite, paging, dedicated public networks, and private systems.
- The growth of mobile data will be driven, in part, by growth in hardware such as laptops, palmtops, pen-based computers, fax machines, and modems which are incorporated with these devices.
- Mobile data applications vary significantly by size and type. Which applications and networks users choose will depend upon their particular needs. The market potential for mobile data, therefore, is great when all current and potential applications are considered.

PCS Providing New Services

- PCS is more of a euphemism for new mobile services than it is a defined technology. PCS services are generally associated with new frequency allocations the FCC will make available to new mobile services in the next several years. PCS services are also usually associated with small size cells that would provide service in very limited geographic areas, whether in-building or out-

side coverage. PCS services are expected to be priced lower than today's existing mobile services.

- Because PCS services are as yet undefined, a wide range of market estimates are being talked about within the mobile industry. Conservatively, PCS services should be serving many millions of subscribers by the year 2000.

Wireless Market Projections

Over the next decade, wireless services will begin to overtake traditional wired telecommunications in terms of importance. By 2000, cellular and paging combined is projected to reach 60 million users, while SMR is projected to reach 4.2 million, mobile satellite is projected to reach 2 million subscribers, and mobile data is projected to reach 16 million subscribers. Mobile data, as mentioned earlier, includes users on cellular, paging, SMR, and mobile satellite services, as well as on dedicated public networks and private networks. Thus, EMCI's projection of 16 million mobile data users does not, for the most part, represent additional wireless subscribers. When crossover among technologies is considered, EMCI projects a total U.S. wireless market of approximately 55 million subscribers by the year 2000, increasing by over 30 million subscribers from 1992 levels. This number of wireless subscribers represents approximately 20% penetration of the U.S. population in the year 2000.

In addition to the aforementioned wireless services, PCS will likely be introduced by 1996, and will further increase the total number of wireless subscribers. Since PCS has not been fully defined nor licensed, it is difficult to project the number of subscribers by 2000. EMCI, however, projects there will be at least several million PCS subscribers, some of which will be crossover subscribers of other technologies.



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